REMARKS

Claims 1-6, 29-35, 38-41, 43, and 44 are pending in the application. Claims 1-6, 29-35, 38-41, 43, and 44 stand rejected. Claims 35, 38, 41, and 44 are being amended. No new matter is believed to be introduced by the amendment.

Rejections Under 35 U.S.C. §103(a)

Claims 1, 4-6, 29-30, and 32-34 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti *et al.* (U.S. Patent No. 5,933,421, hereinafter referenced as "Alamouti") in view of Paulraj *et al.* (U.S. Patent No. 5,345,599, hereinafter referenced as "Paulraj"), further in view of Jenness (U.S. Patent No. 5,373,300, hereinafter referenced as "Jenness"), and further in view of Bell (U.S. Patent No. 6,115,762, hereinafter referenced as "Bell").

Remarks Regarding Alamouti

Alamouti employs a system in which a base station receives a first incoming signal, including a plurality of first Orthogonal Frequency Division Multiplexed (OFDM) frequency tones F2, in a first frequency band, from a first remote station U, during a first Time Division Multiple Access (TDMA) interval. The base station also receives a second incoming signal, including a plurality of second OFDM frequency tones F4, in the first frequency band, from a second remote station W, during a second TDMA interval. The first and second remote stations, U and W, receive the first and second sets of discrete frequency tones F2 and F4 during different periods of time (see Fig. 1 and Column 9, line 19-65 of Alamouti).

Alamouti, as acknowledged by the Office Action, fails to partition the receiving elements into groups, with at least one group containing more than one element.

Remarks Regarding Paulraj

Paulraj describes a spatial filter that receives signals from receiver front-ends and separates the received signal into multiple distinct transmitted components. The spatial filter includes a group of channels, each of which accepts the received signals and operates on them

with single or multi-tap tapped delay line filters with adjustable weights. The spatial filter employs *a priori* information and input and output signals of the spatial filter to determine the optimum weights used for weight adjustment. The outputs of the spatial filter are sent to a demodulator or decoder for further processing.

Referring to Fig. 6 of Paulraj (cited by the Office Action), a spatial filter is used to separate *m* received input signals into the *d* distinct transmitted *signal components*. Subsequently, corresponding *d* spatial filter channels are used to accept *m* inputs and operate on these with *d* single or multi-tap tapped delay line filters to yield *d* desired outputs.

Therefore, Paulraj merely separates *m* signals (and not receiving elements) into *d* signal components. Paulraj offers no suggestion of dividing receiving elements (physical beings and not signals) into groups.

Remarks Regarding Jenness

Jenness relates to antenna devices that are utilized for cellular communications. These antenna devices generally include multiple antenna elements that, in turn, include elements that are separated by a minimum distance and are oriented normal to each other in space to provide the necessary separation and spatial diversity needed for enhancing efficiency of communications (see column 1, line 63 to column 3, line 5, as also referenced by the Office Action). Jenness separates antenna elements by a minimum distance and offers no description of antenna elements that are partitioned into a plurality of groups such that at least one group includes multiple receiving elements located no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering.

Remarks Regarding Bell

Bell separates receiving antenna elements an appropriate distance, relative to the wavelength of the signal to be received, to design a system in which one of the antenna elements is in a position where the signal has not experienced significant degradation due to multi-path effects (see column 3, line 53 to column 4, line 5, as also referenced by the Office Action). Referring to Fig. 5 of Bell, an embedded antenna includes multiple radiating and/or receiving elements. The elements of embedded antenna are spaced, by a distance related to the wavelength

of the signal being received, to provide diversity to combat multi-path propagation problems. This use of two receiving elements separated by an appropriate distance is known in the art as "spatial diversity."

Although Bell partitions the individual antenna elements by "an appropriate distance," Bell offers no suggestion of partitioning "the receiving elements ... into a plurality of groups" such that each group contains "at least one receiving element" and "at least one group" includes "multiple receiving elements" that are positioned "no farther apart than a predetermined maximum receiving element spacing," as required by Applicants' Claim 1.

Obviousness Rejections

As noted above, Alamouti offers no suggestion of receiving elements partitioned into groups. Paulraj merely divides a group of signals into signal components and offers no suggestion of partitioning "receiving elements." Jenness merely separates individual antenna elements by a minimum distance. Similarly, Bell partitions individual antenna elements by "an appropriate distance." These references, independently or combined, do not teach or suggest partitioning receiving elements into a plurality groups such that at least one group includes multiple elements.

Therefore, a hypothetical system combining the teachings of Paulraj, Alamouti, Jenness, and Bell may include antenna elements positioned at preset or appropriate distances from one another, but would not include partitioning receiving elements "into a plurality of groups." Given that the hypothetical system would have no notion of elements partitioned into groups, the hypothetical system cannot include "multiple receiving elements located no farther apart than a predetermined maximum receiving element spacing" within each group, as recited in Applicants' Claim 1.

One of ordinary skill in the art would not be motivated to modify the hypothetical system to behave as recited in Applicants' Claim 1 because the cited references are not designed to operate within partitioned groups. Rather, in contrast to Applicants' Claim 1, these references are designed to operate without partitioning the receiving elements into groups. Therefore, a modification that would enable the hypothetical system to operate within the partitioned group

would require substantial modification, effectively changing its principles of design, and only be done in hindsight of Applicants' teachings.

Therefore, it is Applicants' position that Claim 1 is allowable over Paulraj in view of Alamouti, Jenness, and Bell. Accordingly, Applicants respectfully request that the rejection of this claim under 35 U.S.C. § 103(a) be withdrawn.

Claim 29 includes similar elements as Claim 1. Accordingly, Applicants respectfully request that the rejection of this claim under 35 U.S.C. § 103(a) be withdrawn.

Because Claims 4-6, 30, and 32-34 depend from Claims 1 and 29, Applicants respectfully submit that these claims should be allowed for at least the same reasons as the base claims from which they depend.

Claims 2, 3, 30, and 31

Claims 2 and 30 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Gardner (U.S. Patent No. 5,260,968, hereinafter referred to as Gardner).

Claims 3 and 31 were rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Chang *et al.* (U.S. Patent No. 5,414,433, hereinafter referred to as Chang).

Gardner is being combined with Alamouti, Paulraj, Jenness and Bell because these references do not teach "receiving element spacing no more than one half times a wavelength." Gardner may do so, but Gardner does not teach or suggest having "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claims 1 and 29.

Chang is being combined with Alamouti, Paulraj, Jenness, and Bell because these references do not teach a "predetermined minimum spacing no more than five times a wavelength." However, Chang does not teach or suggest having "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time,

the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claims 1 and 29.

Rejected Claims 2, 3, 30, and 31 depend from base Claims 1 and 29. As explained above, Alamouti, Paulraj, Jenness, and Bell do not teach all of the elements recited in base Claims 1 and 29. These limitations of Alamouti, Paulraj, Jenness, and Bell are not cured by Gardner and Chang. Therefore, without discussing or acquiescing to the merits of the reasons for rejecting these claims, it is Applicants' position that these claims are allowable over Alamouti, Paulraj, Jenness, and Bell alone or in view of Gardner and Chang. Accordingly, Applicants respectfully request that the rejection of Claims 2, 3, 30, and 31 under 35 U.S.C. § 103(a) be withdrawn.

Claim 35

Claim 35 was rejected under 35 U.S.C. §103(a) as being unpatentable over Alamouti in view of Paulraj, in view of Jenness, further in view of Bell, and further in view of Reece *et al.* (U.S. Patent No. 5,771,024, hereinafter referred to as Reece).

Claim 35 is now amended Support for the amendments can be found in the Application, as originally filed, at least on page 34, lines 19-24.

As explained above, a hypothetical system combining teachings of Paulraj, Alamouti, Jenness, and Bell can only include *single* antenna elements that are positioned at preset or appropriate distances from one another. The combination of these references offers no suggestion of partitioning adaptive antenna arrays into "a plurality of sub-arrays" such that each sub-array includes "at least two receiving elements" that are "located no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as suggested by Applicants' amended Claim 35.

Remarks Regarding Reece

Reece is being combined with Alamouti, Paulraj, and Gardner because these references do not teach "an array fixation structure configured to mount the plurality of adaptive antenna

arrays thereon." However, Reece merely relates to an antenna mount and does not teach or suggest having a "plurality of adaptive antenna arrays including a plurality of sub-arrays, each sub-array including at least two receiving elements, the receiving elements in the sub-arrays being no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as required by Applicants' Claim 35.

Obviousness Rejections

A hypothetical system combining the teachings of Alamouti, Paulraj, Jenness, Bell, and Reece may have an array fixation structure for mounting the plurality of adaptive antenna arrays and space single receiving elements at "an appropriate distance," but it will not have "at least two receiving elements configured to receive the communication signals on a same frequency band at any period of time, the receiving elements being partitioned into a plurality of groups," and "at least one group including multiple receiving elements located proximal to one another and no farther apart than a predetermined maximum receiving element spacing to facilitate spatial filtering," as recited in Applicants' Claim 35.

One of ordinary skill in the art would not be motivated to modify the hypothetical system to be configured to receive the communication signals on a same frequency band at any period of time because this modification would need to alter the operating principles of the hypothetical system to enable the hypothetical system to operate with partitioned groups, as presented above. Such modification would require substantial modification and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 35 under 35 U.S.C. § 103(a) be withdrawn.

Claims 38 and 39

Claims 38 and 39 were rejected under 35 U.S.C. §103(a) as being anticipated by Paulraj in view of Forssen *et al.* (U.S. Patent No. 5,566,209, hereinafter referred to as "Forssen").

Claim 38 is now amended. Support for the amendments can be found in the Application, as originally filed, at least on page 35, line 25 through page 37, lines 14, and in Figs. 3 and 5.

Remarks regarding Paulraj

Referring to Fig. 5 of Paulraj, a receiving station includes *m* receiver front-end outputs that are input to a spatial filter. The spatial filter employs the *m* signals to estimate *d* separate impinging signals. The *d* spatial filter outputs signals that are processed by a *d*-channel demodulator and decoder that demodulates the signals to obtain digital data streams and decodes the data streams to generate the *d* sub-streams. The demodulator outputs are then combined. The combiner is "simply a d-way multiplexer" (see column 8, lines 11-49 and shown in Figs. 5 and 6 of Paulraj) that receives the demodulator/decoder signals, aligns the signals to compensate for differential delays experienced by the signals, and combines the time aligned signals to obtain an estimated source stream.

Paulraj may employ the direction of arrival information to separate co-channel signals into individual signals prior to feeding them into the demodulators. However, in contrast to Applicants' amended Claim 38, Paulraj neither employs the direction of arrival information to construct or combine the signals input nor requires the combined signal to include a pattern that has "a higher relative gain in one or more angular directions and minimizing co-channel interference in other angular directions."

Remarks Regarding Forssen

Forssen employs an adaptation means to adjust spatial filters used to enhance a desired spatial channel (e.g., a training sequence) while suppressing other spatial channels. The adaptation means can adjust the spatial filters in a variety of ways, for example, direction of arrival estimation combined with classification and weighting, direction of arrival estimation combined with least squares minimization of an error signal, direction of arrival estimation with least means squares minimization of an error signal, and direction of arrival estimation combined with a gradient optimizing method can be used to optimize the spatial filters using any known optimization method (see Forssen, column 4, lines 38-57, as also referenced by the Office Action).

Therefore, Forssen merely employs direction of arrival data in combination with factors, such as weighting and minimization of an error signals, to enhance a training sequence used as a desired signal. Foressen's combiner neither constructs "a desired signal response as a function of direction of arrival data of the signals" nor requires the combined signal to include a pattern that has "a higher relative gain in one or more angular directions and minimizing co-channel interference in other angular directions," as required by Applicants' amended Claim 38.

Obviousness Rejections

As noted above, Paulraj neither employs the direction of arrival information to construct or combine the signals input nor requires the combined signal to include a pattern that has "a higher relative gain in one or more angular directions and minimizes co-channel interference in other angular directions." Forssen merely employs direction of arrival data in combination with factors, such as weighting and minimization of error signal(s) to enhance a training sequence used as a desired signal. These references, independently or combined, offer no suggestion of constructing a desired signal response pattern that provides a higher relative gain in one or more angular directions and minimizes co-channel interference in other angular directions.

Therefore, a hypothetical system combining the teachings of Paulraj and Forssen may have a direction of arrival processor, but it will not have a combiner that constructs "a desired signal response pattern" that satisfies the requirements of Applicants' amended Claim 38. One of ordinary skill in the art would not be motivated to modify the hypothetical system to include a combiner that constructs "a desired signal response pattern" because such modification requires significant modification of the hypothetical system (e.g., calibration, careful determination and implementation of gain and phase weightings) and would only be done in hindsight of Applicants' teachings. Specifically, since Foressen merely takes in training sequence and employs the training sequence as its desired signal, one would need to modify the hypothetical system to instead construct the desired signal pattern and satisfy the requirements of Applicants' amended Claim 38. Such modification clearly would require substantial alteration of the hypothetical system, effectively altering its fundamental principles of operation (taking in a desired signal *vs.* constructing a desired signal having certain requirements), and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of amended Claim 38 under 35 U.S.C. § 103(a) be withdrawn.

Because Claim 39 depends from Claim 38, Applicants respectfully submit that this claims should be allowed for at least the same reasons as the base claim from which it depends.

Claim 40

Claim 40 was rejected under 35 U.S.C. §103(a) as being unpatentable over Paulraj in view Foressen and further in view of Alamouti.

Alamouti is being combined with Paulraj and Foressen because these references do not teach employing OFDM. However, as described above, these references do not teach requisite elements of Applicants' amended Claim 38, from which Claim 40 depends.

These limitations of Paulraj and Foressen are not cured by Alamouti. Therefore, without discussing or acquiescing to the merits of the reasons for rejecting this claim, it is Applicants' position that this claim is allowable over Paulraj and Foressen alone or in view of Alamouti. Accordingly, Applicants respectfully request that the rejection of Claim 40 under 35 U.S.C. § 103(a) be withdrawn.

Claims 41 and 44

Claims 41 and 44 were rejected under 35 U.S.C. §103(a) as being anticipated by Ward *et al.* (U.S. Patent No. 6,104,930, hereinafter referenced as Ward) in view of Langlais (U.S. Patent No. 6,091,932, hereinafter referenced as Langlais).

Claim 41

Claim 41 is now amended. Support for the amendments may be found in the Application, as originally filed, at least on page 12, line 19 through page 13, line 17.

Remarks Regarding Ward

Ward employs a system in which each beam is substantially spatially fixed. Ward's beams operate at carrier frequencies that are "sufficiently separated from each other so as not to cause interference with each other or with other beams radiating in adjacent cells." As such, if a

mobile station operating at a carrier frequency falling within a first radiation beam moves out of an area covered by that radiation beam and into an area covered by an adjacent second radiation beam, communication with the base station via the first beam is lost, and the base transceiver station must communicate with the mobile station through the second radiation beam (see column 8, lines 6-10 and Fig.7 of Ward).

Therefore, Ward merely separates beams based on their carrier frequencies to ensure that they do not interfere with each other. Ward offers no suggestion of spacing the frequency bins "in a dominant direction of arrival of signals in each bin" and based on "minimizing signal strength of active bins," as required by Applicants' amended Claim 41.

Remarks Regarding Langlais

Langlais explains that since OFDM employs a large number of narrow band sub-carriers, a symbol period in an OFDM system may be hundreds to thousands of times greater than other systems. In order to prevent intersymbol interference, Langlais merely increases a sample period such that the symbol times are much longer than significant echo paths (see column 4, lines 52-55, as also referenced by the Office Action).

Therefore, Langlais merely suggests increasing a symbol period to prevent inter-symbol interference. Langlais does not teach or suggest spacing the frequency bins "in a dominant direction of arrival of signals in each bin" and based on "minimizing signal strength of active bins," as required by Applicants' amended Claim 41.

Obviousness Rejections

Described above, Ward merely separates beams based on their carrier frequencies to ensure that they do not interfere with each other. Langlais merely suggests increasing a symbol period to prevent inter-symbol interference. Ward and Langlais, independently or combined, do not teach or suggest spacing the frequency bins "in a dominant direction of arrival of signals in each bin" and based on "minimizing signal strength of active bins," as required by Applicants' amended Claim 41.

A hypothetical system combining the teachings of Ward and Langlais may prevent inter-symbol interference, but it would not space the frequency bins "in a dominant direction of arrival of signals in each bin" and based on "minimizing signal strength of active bins."

One of ordinary skill in the art would not be motivated to modify the hypothetical system to includes elements recited in Applicants' Claim 41 because such modification requires significant alteration of the hypothetical system and would only be done in hindsight of Applicants' teachings. For example, the hypothetical system would need to be modified to determine and operate based on dominant direction of arrival of signals instead of operating based on an increased symbol period. Such modification requires significant alteration and would only be done in hindsight of Applicants' teachings.

Accordingly, Applicants respectfully request that the rejection of Claim 41 under 35 U.S.C. § 103(a) be withdrawn.

Claim 44

Claim 44 is now amended. Support for the amendments may be found in the Application, as originally filed, at least on page 12, line 19 through page 13, line 17.

Remarks regarding Ward

In addition to what was described above, Ward maintains a pool of unassigned and allowable individual carrier frequencies. Depending on the number of incoming calls, these individual carrier frequencies are allocated based on traffic activity. Ward monitors underutilized carrier frequencies (i.e., carrier frequencies having a number of vacant communication channels) and reallocates these time slots to other carrier frequencies on the beam (see column 10, line 37 to column 11, line 42 of Ward).

Therefore, Ward merely assigns unassigned carrier frequencies based on traffic activity. Ward does not teach or suggest "distributing the bins within the frequency blocks as a function of power of the bins," as recited in Applicants' Claim 44.

Obviousness Rejections

As noted above, Ward merely assigns unassigned carrier frequencies based on traffic activity and Langlais only suggests increasing a symbol period to prevent inter-symbol interference. These references, independently or combined, do not teach or suggest "distributing the bins within the frequency blocks as a function of power of the bins," as recited in Applicants' Claim 44.

A hypothetical system combining the teachings of Ward and Langlais may prevent inter-symbol interference, but it would not distribute "the bins within the frequency blocks as a function of power of the bins."

One of ordinary skill in the art would not be motivated to modify the hypothetical system to include elements recited in Applicants' Claim 44, because such modification requires substantial modification of the hypothetical system and would only be done in hindsight of Applicants' teachings. For example, the hypothetical system would need to determine power of the bins and distribute the bins based on the power of the bins.

Accordingly, Applicants respectfully request that the rejection of Applicants' Claim 41 under 35 U.S.C. § 103(a) be withdrawn.

Claim 43

Claim 43 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ward.

As explained above, Ward maintains a pool of unassigned and allowable individual carrier frequencies. Depending on the number of incoming calls, these individual carrier frequencies are allocated based on traffic activity.

Therefore, Ward merely assigns unassigned carrier frequencies based on traffic activity. Ward does not teach or suggest "assigning the second remote user to a second frequency bin based at least in part on the directions of signal arrival such that directions of signal arrival for adjacent frequency bins differ," as recited in Applicants' Claim 43.

One of ordinary skill in the art would not be motivated to modify Ward to include elements recited in Claim 43, because such modification requires substantial modification of the hypothetical system and would only be done in hindsight of Applicants' teachings. For example,

the modification requires that Ward's system be altered to assign the bins based on direction of arrival as opposed to traffic activity.

Accordingly, Applicants respectfully request that the rejection of Claim 43 under 35 U.S.C. § 103(a) be withdrawn.

Supplemental Information Disclosure Statement

A Supplemental Information Disclosure Statement (SIDS) is being filed concurrently herewith. Entry of the SIDS is respectfully requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all currently pending claims, claims 1-6, 29-35, 38-41, 43, and 44, are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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